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Published

(54) Title: DEVICE FOR A TOOL SPINDLE

(54) Titre: DISPOSITIF POUR BROCHE PORTE-OUTIL

(57) Abstract

Tool spindle with a moveable pulling rod (3) axially displaceable in the spindle axle (1) for firmly attaching a tool at the axle of the spindle. The end (10) of the pulling rod (3) that is opposite to the tool extends into a unit (4) that accommodates the end of the pulling rod and that is stationary in relation to the rotating pulling rod, in which there is a spool (9) surrounding the pulling rod (3) for sensing the axial position of this in the spindle axle (1), the pulling rod is provided with an axial, central hole (6) for leading a coolant agent under pressure to the bit of the tool, whereby the coolant is supplied to the bore (6) of the pulling rod (3) via the stationary unit, that the pulling rod (3) is provided with a piston (11) accommodated in a cylinder chamber (13) arranged in the spindle axle (1) and having at least a first (12b) and a second (12a) axial bore of which the first bore (12b) opens in the cylinder chamber (13) on one side of the piston (11) and the second bore (12a) opens in the cylinder chamber (13) on the other side of the piston (11) and that the first bore (12b) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in one direction to attach firmly the tool at the tool spindle, and the second bore (12a) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in the other direction to detach the tool, that the spindle axle (1) for its cooling and that of a rotor (22) attached on to it, is provided with at least one essentially axial first and second channel (20a, 20b), whereby the first channel (20b), via a restriction (21), opens into the cylinder chamber (13) on the side of the piston (11) that is put under pressure for displacing the pulling rod (3) in a direction to attach firmly the tool, and that the second channel (20a) opens into the second bore (12a) of the pulling rod (3) for leading the fluid back to source of fluid via the unit (4), and that the pulling rod has at least one bore (12c) in communication with unit (4) via an inlet (17) to supplying scavenging air and to lead the scavenging air to the tool end of the spindle axle via spindle axle (1).

(57) Abrégé

Cette invention concerne une broche porte-outil avec une tige d'extraction (3) mobile qui se déplace axialement dans la broche (1) et qui permet de fixer un outil sur ladite broche. L'extrémité (10) de la tige d'extraction (3) située sur le côté opposé à l'outil pénètre une unité (4) qui est fixe par rapport à la tige d'extraction tournante, et dans laquelle se trouve un tiroir (9) qui entoure la tige d'extraction (3). Ce tiroir détecte la position axiale de la broche (1). La tige d'extraction (3) comporte un trou axial central (6) qui amène un agent réfrigérant sous pression jusqu'à l'outil rapporté via l'unité stationnaire. La tige d'extraction (3) comporte un piston (11) logé dans une chambre cylindrique (13) elle même disposée dans la broche (1). Ce piston comprend au moins un premier (12b) et un second (12a) alésages axiaux. Le premier alésage (12b) débouche dans la chambre cylindrique (13) sur l'un des côtés du piston (11), le second alésage (12a) sur la chambre cylindrique (13) sur l'autre côté du piston (11). Le premier alésage (12b) est pressurisé au moyen d'un liquide via l'unité (4), ce qui déplace le piston (11) et, ipso facto, la tige d'extraction (3), avec pour conséquence d'arrimer l'outil sur la broche. De même, le second alésage (12a) est pressurisé au moyen d'un liquide via l'unité (4), ce qui déplace le piston et donc la tige d'extraction (3) dans l'autre sens et, par là, libère l'outil. Pour son refroidissement et celui d'un rotor (22) qui lui est solidaire, la broche (1) comporte au moins un premier et un second canaux essentiellement axiaux (20a, 20b). Le premier canal (20b), via une restriction (21), débouche dans la chambre cylindrique (13) située sur le côté du piston (11) pressurisé grâce auquel la tige d'extraction (3) peut être déplacée dans le sens de fixation de l'outil. Le second canal (20a) débouche sur le second alésage (12a) de la tige d'extraction (3) par lequel le liquide est rappelé via l'unité (4). La tige d'extraction (3) comporte au moins un alésage (12c) qui communique avec l'unité (4) via une admission (17) et fournit de l'air de rappel et dirige cet air vers l'extrémité outil de la broche (1).

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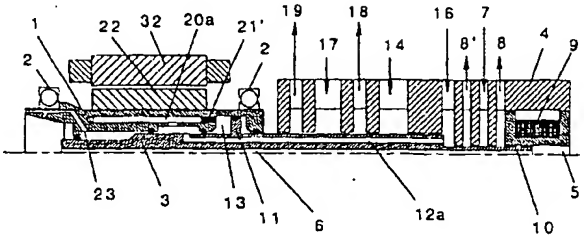
(54) Title: DEVICE FOR A TOOL SPINDLE



(57) Abstract

Tool spindle with a moveable pulling rod (3) axially displaceable in the spindle axle (1) for firmly attaching a tool at the axle of the spindle. The end (10) of the pulling rod (3) that is opposite to the tool extends into a unit (4) that accommodates the end of the pulling rod and that is stationary in relation to the rotating pulling rod, in which there is a spool (9) surrounding the pulling rod (3) for sensing the axial position of this in the spindle axle (1), the pulling rod is provided with an axial, central hole (6) for leading a coolant agent under pressure to the bit of the tool, whereby the coolant is supplied to the bore (6) of the pulling rod (3) via the stationary unit, that the pulling rod (3) is provided with a piston (11) accommodated in a cylinder chamber (13) arranged in the spindle axle (1) and having at least a first (12b) and a second (12a) axial bore of which the first bore (12b) opens in the cylinder chamber (13) on one side of the piston (11) and the second bore (12a) opens in the cylinder chamber (13) on the other side of the piston (11) and that the first bore (12b) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in one direction to attach firmly the tool at the tool spindle, and the second bore (12a) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in the other direction to detach the tool, that the spindle axle (1) for its cooling and that of a rotor (22) attached on to it, is provided with at least one essentially axial first and second channel (20a, 20b), whereby the first channel (20b), via a restriction (21), opens into the cylinder chamber (13) on the side of the piston (11) that is put under pressure for displacing the pulling rod (3) in a direction to attach firmly the tool, and that the second channel (20a) opens into the second bore (12a) of the pulling rod (3) for leading the fluid back to source of fluid via the unit (4), and that the pulling rod has at least one bore (12c) in communication with unit (4) via an inlet (17) to supplying scavenging air and to lead the scavenging air to the tool end of the spindle axle via spindle axle (1).

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Description

previously mentioned in connection with the coolant liquid, the hydraulic liquid will also leak in the gap sealings between unit 4 and the pulling rod 3 both to the right and to the left when seen in the figure. The pressurised fluid provided through inlet 14 is restricted to its left (Fig. 2) by a gap sealing as well as an outlet 18 or a channel with atmospheric pressure and to the right of the gap sealing by the gap sealing plus the inlet 16, which as already mentioned is now not under pressure. Pressurised air (blocking air) is also provided through an inlet 17 of unit 4 that is divided in a radial plane, which also prevents further leakage of hydraulic fluid to the left (in the figure) and that together with the leaking hydraulic fluid, exits unit 4 via outlet 18. To reduce or prevent leakage of pressurised air from inlet 17 into the actual spindle, an outlet 19 with a lower pressure (atmospheric pressure) is arranged to the left of inlet 17.

Bore 12a is open at the inlet 17 and opens to the right of piston 11, while the second bore 12b is provided with openings 14', is sealed at the end adjacent to inlet 16, and opens in the cylinder chamber 13 on the left-hand side of the piston.

In the case where fluid bearing 24 is used, see Fig. 5, and the spindle has the design shown there, the hydraulic fluid is led under pressure through inlet 16 and bore 12a to detach the tool. To attach the tool firmly, bore 12b is put under pressure via inlet 14 to displace piston 11 to the right in the figure. In this way, the hydraulic fluid situated to the right of the piston to be found in the bore 12a is pressed out through the now depressurised inlet 16. When detaching the tool, the reverse takes place and the hydraulic fluid is pressed out through the now depressurised inlet 14.

Cooling the spindle at the connection to the rotor

The tool (not shown) is attached firmly, as stated, by the displacement of the pulling rod 3 into the tool spindle, which takes place through the hydraulic fluid under pressure being supplied via inlet 14 of unit 4 through the second channel 12b to the cylinder chamber 13 on the side of the piston facing the tool, as shown in Fig. 2. Spindle axis 1 is, as shown, provided with a number of axial channels 20a, b distributed peripherally, for example twelve channels (see Fig. 6), that open into the cylinder chamber 13. Six channels 20b of these twelve channels have restrictions 21 at the connection with the cylinder chamber 13 for maintaining the pressure in the cylinder chamber and for controlling the desired amount of flow in the channels 20a, and they are, at the opposite ends to their restrictions, connected with the other six channels 20a, that are plugged tight 21' at the cylinder chamber 13. Instead, these latter six channels 20a open at the first bore 12a of the pulling rod 3, which is inactive under these conditions, to lead away the hydraulic fluid via the inlet 16 that is inactive while the tool is attached.

The feed system 24F for supplying fluid to the fluid bearing 24 of the tool spindle is shown furthest to the left in Fig. 8. The fluid is supplied to the system with a pressure of, for example, 100 bar and flows through a pressure monitor 241, a check valve 242, and accumulator 243, suitably a flow monitor 244, a check valve 245 to be then led to the spindle via at least two supply channels 246 that are independent of one another and include a respective pressure monitor 247. The different components have in principle a function that is equivalent to that previously described in connection with system 7F and 16F. The task of the flow monitor 244 is to register that the correct amount of fluid - flow - passes.

Hydraulic circuit 14F is arranged for adjusting the hydraulic system, for the pressure-setting of the different sides of the piston 11 for attaching or removing the tool. A branched line, to which a regulator 141 and a check valve 142 is connected, is arranged after the accumulator 243 in circuit 24F and before the flow monitor 244, after which the branched line connects to a multi-way valve, a so-called four-two valve or cross-parallel valve 143. The regulator is adjusted to a pressure of, for example, 60 bar. The pressurised hydraulic fluid is led out via valve 143 through at least two supply channels 144 that are independent of one another and provided with pressure monitors, and in via the inlet 14 of the tool spindle for displacing the piston 11 to the right (see Fig.) and attaching the tool. During this process, the line 145 connected from the valve 143 to the inlet 16 of the tool spindle is not under pressure so that the hydraulic fluid can be led away. To remove the tool, the valve 143 is turned so that pressure is released from the connection 144 and the line 145 is pressurised. To sense that the line 145 has the desired pressure, a pressure monitor 146 is arranged in the line. The return of the said fluid is led away via line 147.

Part of the branched line 707 connected to system 5F between check valve 502 and pressure monitor 503 extends from system 7F after its regulator 705 via check valve 708. Another part of the branched line 707 connects to system 24F upstream of its supply channels 247 via a check valve 708a. Branched line 707 also connects to valve 143 of system 14F via a check valve 709, and similarly via a check valve 710 to system 16F downstream of its check valve 166.

If, for example, a malfunction occurs in system 5F and the pressure in this falls below 4 bar, for example, which is the pressure prevailing in branched line 707, and the spindle axle stops, air from system 7F with an initial pressure of 4 bar will flow from system 7F into the bore 6 of the spindle axle to remove the coolant fluid from the affected parts of the spindle axle and to, to a certain extent, contribute to the cooling of the tool. Check valve 708 will naturally prevent the coolant fluid in system 5F forcing its way into branched line 707.

In the equivalent way, if the pressure in system 4F falls below 4 bar, or if another fault arises and the spindle stops, air from system 7F will open check valve 710 and force away the fluid currently prevailing in the spindle and, to a certain extent, contribute to the cooling of the tool.

The equivalent applies during an unauthorised pressure drop or other malfunction to feed system 14F via check valve 709 and valve 143, and/or feed system 24, during malfunction, via check valve 708a with pressurised air from system 7F to remove fluid that is not appropriate there.

The said pressure and flow monitors signal when the prevailing values lie outside of the intended limits and cut off the supply of energy to the spindle axle.

Alternative embodiment

The invention described here is not limited to exactly the design described as the tool spindle can naturally be given another construction. For example, the spindle axle 1 can extend into and be accommodated by the stationary part 4, whereby the gap sealings will be located between this and the spindle axle 1. In this case, it is possible to position the axial bores 12a, 12b for hydraulic fluid in the spindle axle 1 instead of the pulling rod 3.

The pressures specified in connection with the described supply system are appropriate but are given only as examples and can naturally vary depending on different parameters. Parts 244-247 do not apply when ball-bearings are used and instead, the system have lubricant monitoring of the ball-bearings added to it.

Similarly, it should be emphasised that the schematically indicated ball and fluid bearings 2 and 24 respectively have what is a *per se* known axle bearing function, which has been omitted in order not to make the description and drawings more complicated than necessary.

Claims

Claims

1. Tool spindle with a moveable pulling rod (3) axially displaceable in the spindle axle (1) for firmly attaching a tool at the axle of the spindle c h a r a c t e r i s e d in that the end (10) of the pulling rod (3) that is opposite to the tool extends into an unit (4) that accommodates the end of the pulling rod and that is stationary in relation to the rotation of the pulling rod, in which there is a spool (9) surrounding the pulling rod (3) for sensing the axial position of this in the spindle axle (1), that the pulling rod is provided with an axial, central hole (6) for leading a coolant agent under pressure to the bit of the tool, whereby the coolant under pressure is supplied to the bore (6) of the pulling rod (3) via the stationary unit (4), that the pulling rod (3) is provided with a piston (11) accommodated in a cylinder chamber (13) arranged in the spindle axle (1) and having at least a first (12b) and a second (12a) axial bore of which the first bore (12b) opens in the cylinder chamber (13) on one side of the piston (11) and the second bore (12a) opens in the cylinder chamber (13) on the other side of the piston (11) and that the first bore (12b) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in one direction to attach firmly the tool at the tool spindle, and the second bore (12a) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in the other direction to detach the tool, that the spindle axle (1) for its cooling and that of a rotor (22) attached on to it, is provided with at least one essentially axial first and second channel (20a, 20b), whereby the first channel (20b), via a restriction (21), opens into the cylinder chamber (13) on the side of the piston (11) that is put under pressure for displacing the pulling rod (3) in a direction to attach firmly the tool, and that the second channel (20a) opens into the second bore (12a) of the pulling rod (3) for leading the fluid back to source of fluid via unit (4), and that the pulling rod has at least one bore (12c) in communication with the unit (4) via an inlet (17) to supply scavenging air and to lead the scavenging air to the tool end of the spindle axle via spindle axle (1).

2. Tool spindle with a moveable pulling rod (3) axially displaceable in the spindle axle (1) for firmly attaching a tool at the axle of the spindle c h a r a c t e r i s e d in that the end (10) of the pulling rod (3) that is opposite to the tool extends outside of the spindle axle (1) and into an unit (4) that accommodates the end of the pulling rod and that is stationary in relation to the rotation of the connecting rod, in which there is a spool (9) surrounding the pulling rod (3) for sensing the axial position of this in the spindle axle (1), that the pulling rod is provided with an axial, central hole (6) for leading coolant under pressure to the bit of the tool, whereby the coolant under pressure is supplied to the bore (6) of the pulling rod (3) via the stationary unit (4), that the pulling rod (3) is provided with a piston (11) accommodated in a cylinder chamber (13) arranged in the spindle axle (1) and

having at least a first and a second (12a, 12b) axial bore of which the first bore (12b) opens in the cylinder chamber (13) on one side of the piston (11) and the second bore (12a) opens in the cylinder chamber (13) on the other side of the piston (11) and that the first bore (12b) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in one direction to attach firmly the tool at the tool spindle, and the second bore (12a) is put under pressure with fluid via the unit (4) to displace the piston (11) and thereby the pulling rod (3) in the other direction to detach the tool, that the spindle axle (1) for its cooling and that of a rotor (22) attached on to it, is provided with one or more essentially axial cooling channels (26) in communication with at least one axial bore (12d) arranged in the pulling rod that is connected with a inlet (25) of the unit (4) for coolant and where the cooling channels (26) open on the outside of the spindle axle for leading away the coolant.

3. Tool spindle according to claim 2 c h a r a c t e r i s e d in that the spindle axle (1) and its electric motor (22, 32) are surrounded by an atmosphere under pressure enclosed by a stationary housing (33) having gap sealings against the rotating parts (1, 3) of the tool spindle on either side of the electric motor to prevent coolant forcing its way into the motor (22, 32).

4. Tool spindle according to claim 1 c h a r a c t e r i s e d in that inlet (5) is arranged to lead in the coolant under pressure to the central hole (6), that inlet (14, 16) is arranged to lead in the coolant under pressure to the first and the second bores (12b 12a), whereby an inlet (7, 17) for gas under pressure is arranged on at least one side of respective inlet (5; 14, 16) and that an outlet (8, 8', 18) is arranged between the respective inlet (7, 17) for gas under pressure and inlet for coolant and fluid under pressure (5; 14, 16) is connected to a pressure lower than the pressure of the coolant and fluid, whereby the gas under pressure in inlet (7, 17) has a pressure greater than the pressure in outlet (8, 8', 18).

5. Tool spindle according to claim 1 or 4 c h a r a c t e r i s e d in that the tool spindle is supported on ball-bearings (2).

6. Tool spindle according to claim 2 or 3 c h a r a c t e r i s e d in that the tool spindle is supported on liquid bearings (24).

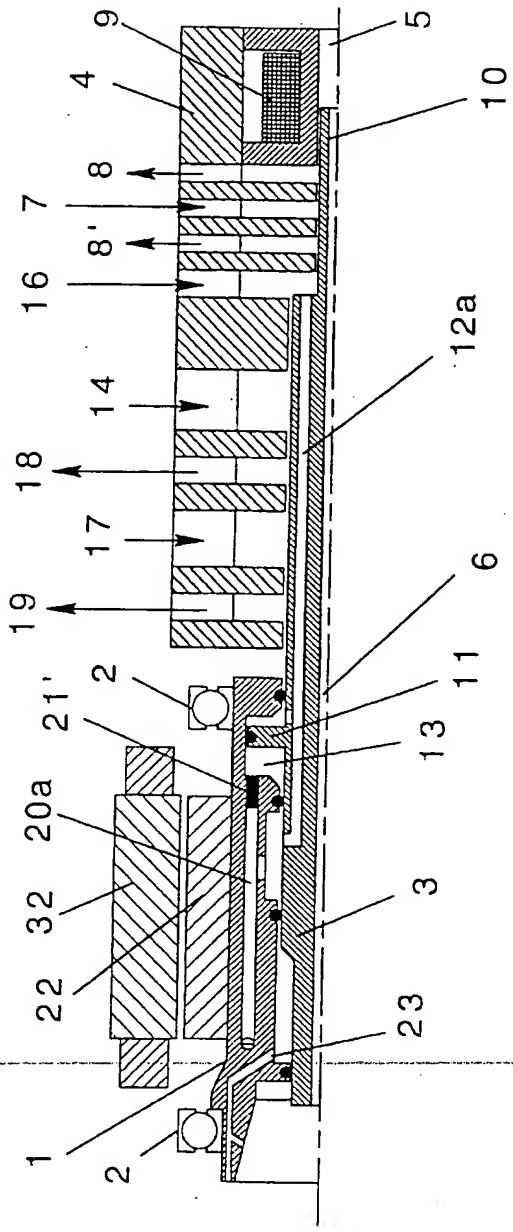

Fig 1

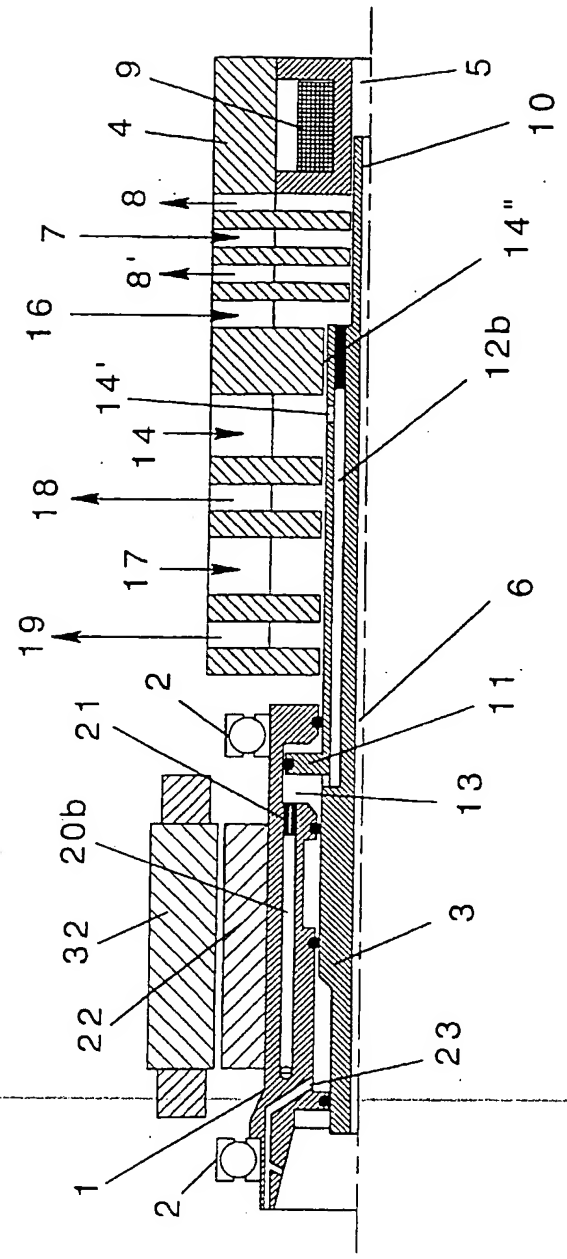

Fig 2

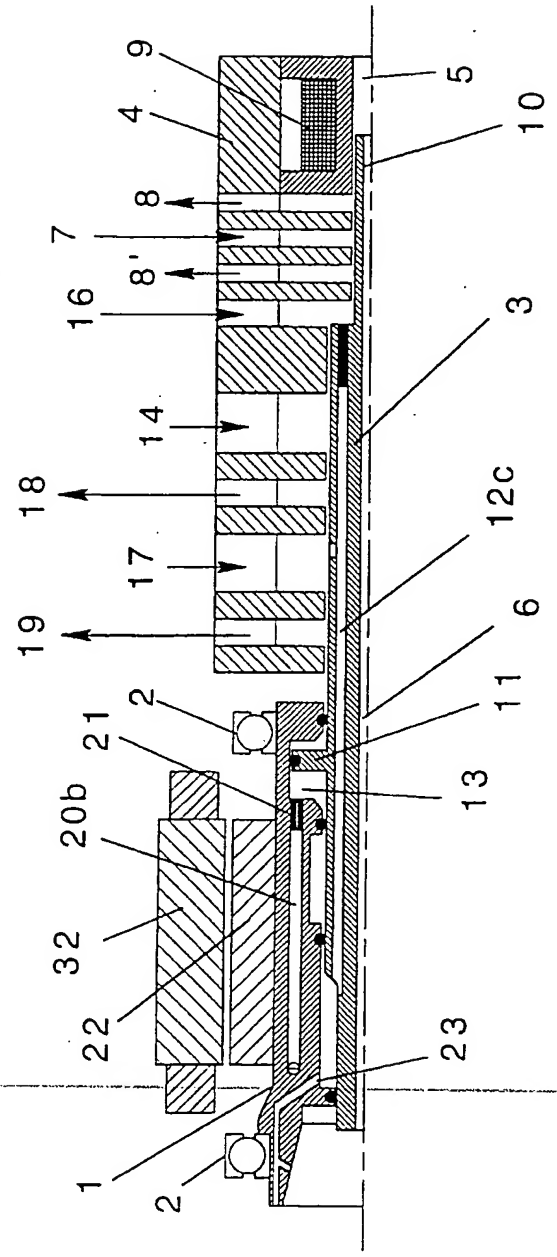

Fig 3

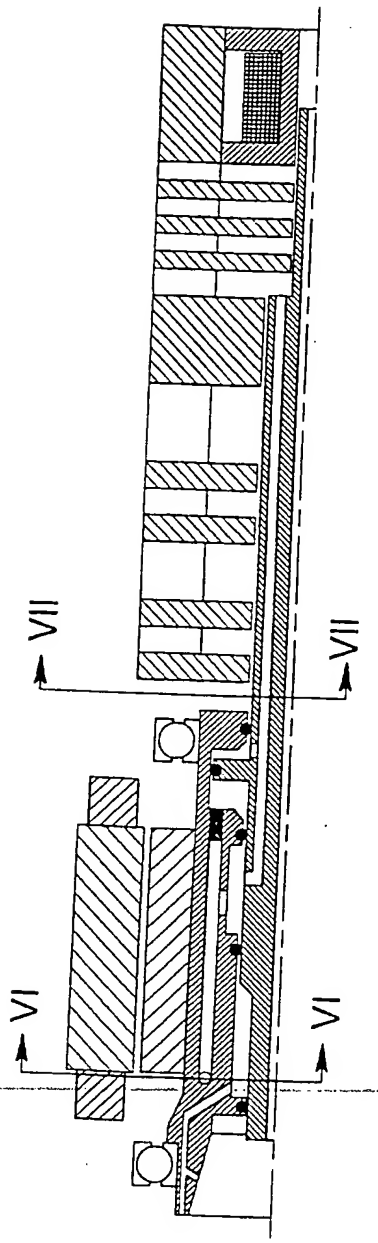

Fig 4

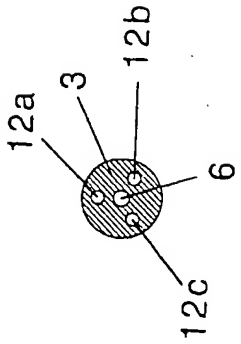

Fig 7

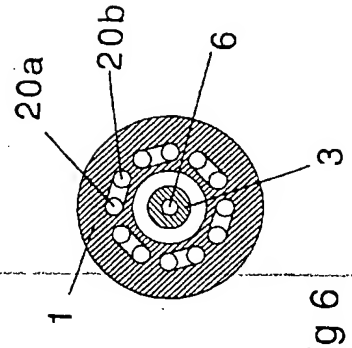

Fig 6

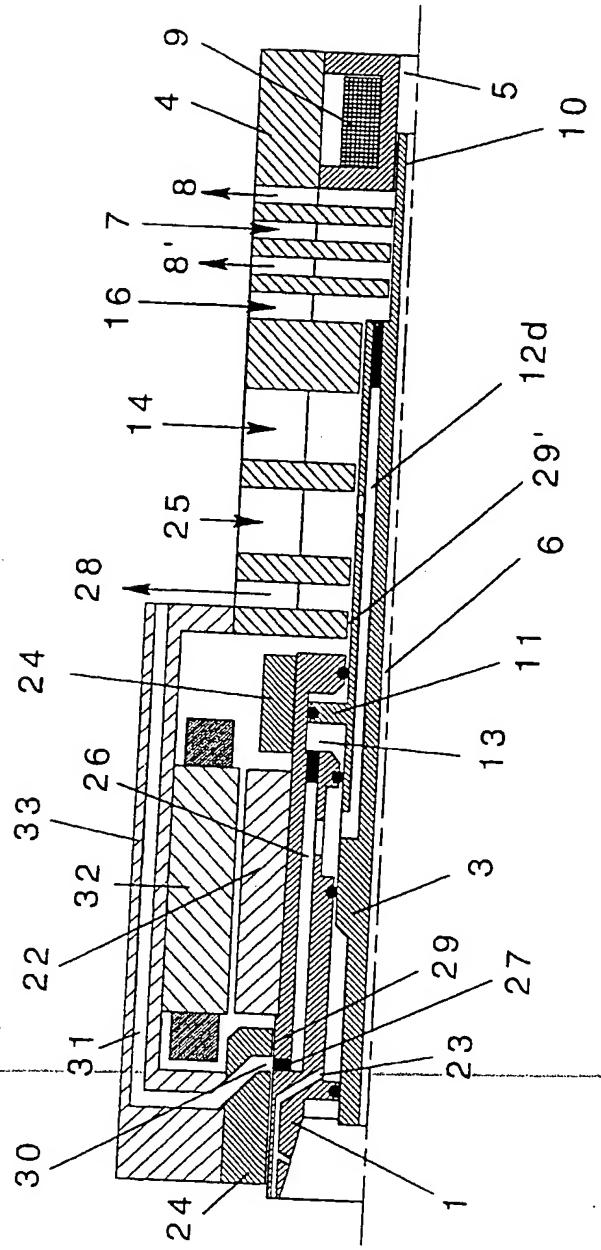
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Fig 5

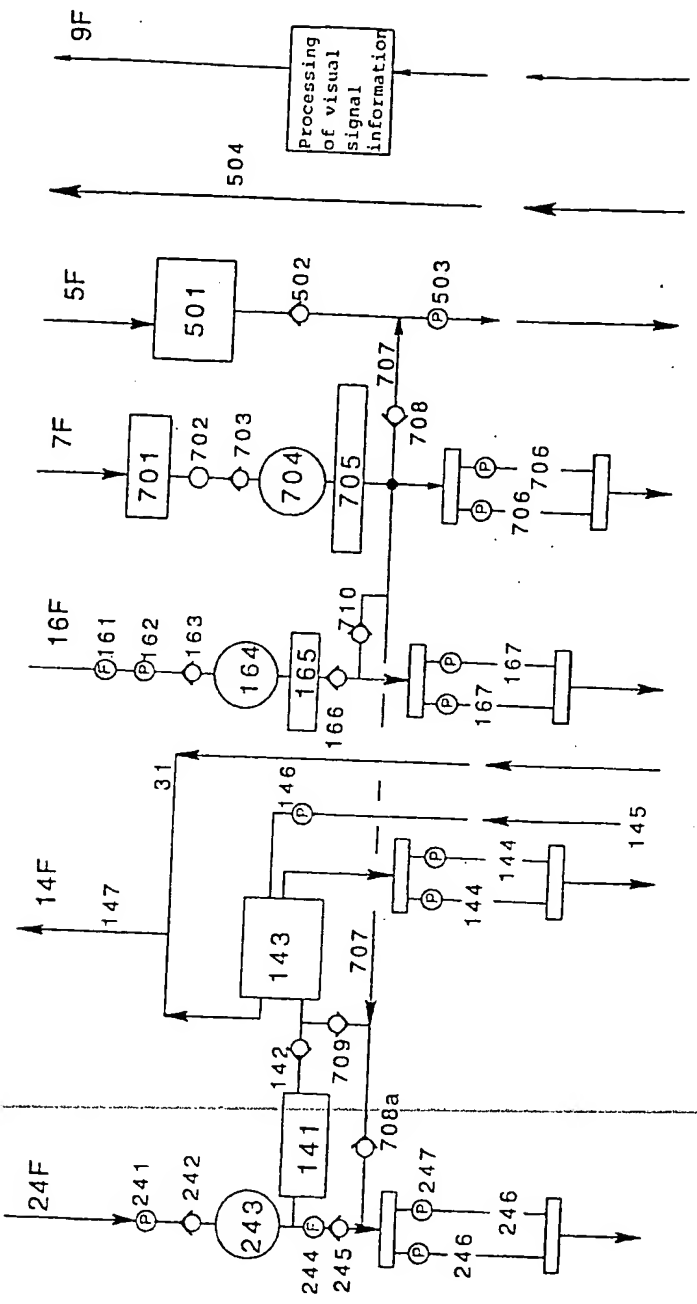
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Fig 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/00100

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B23B 31/30, B23Q 17/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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IPC7: B23B, B23Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0294547 A1 (SMW SCHNEIDER & WEISSHAUPT GMBH), 14 December 1988 (14.12.88), figure 1, abstract --	1-6
A	EP 0852170 A2 (THE INGERSOLL MILLING MACHINE COMPANY), 8 July 1998 (08.07.98), figure 1, abstract -- --------	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2000	16 -05- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Joakim Movander / JA A Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0294547 A1	14/12/88	DE 3719102 A	15/12/88
EP 0852170 A2	08/07/98	JP 10202403 A	04/08/98